SHORT-COMINGS IN THE PRESENT STANDARD METHODS OF WATER ANALYSIS FROM THE OPERATOR'S VIEWPOINT[1]

By Lewis I. Birdsall[2]

The following paragraph is quoted from the Preface to the First Edition of the Report of the Committee on Standard Methods of Water Analysis. The italics are inserted by the present writer.

> Detailed descriptions of the various methods recommended are given in concise form, covering the essential features of each determination. *It is assumed that those using these directions are thoroughly grounded in the fundamental principles of chemistry and biology, and that they are also familiar with the leading literature upon the subject.* So many satisfactory text books upon chemical analysis in general and on water analysis in particular are in existence that it is unnecessary to give a complete detailed description of all procedures, but it is fully recognized that in many cases the adherence to certain details is an essential matter, and hence for the newer methods they are incorporated in this report.

Conditions have changed materially since 1904 when the above quoted paragraph was written. At that time well established laboratories all over the United States and Canada were using different methods of water analysis and the great question for the Committee on Standard Methods to solve was that of selecting methods of analysis which would be adopted as uniform procedure by all these laboratories. The men who formulated the report and those in charge of the water laboratories at that time were all "thoroughly grounded in the fundamental principles of chemistry and

[1] At the request of the Editor the writer presents in this paper his criticisms of the present standard methods of water analysis from the viewpoint of a water purification plant operator. The paper was prepared in order to indicate what line of action the Association might take to increase the value of "standard methods" to the operator.

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biology," and were no doubt "familiar with the leading literature upon the subject." During the seventeen years that have elapsed, however, there have been great changes both in the number of laboratories analysing water and in the calibre of the analysts themselves. The great increase in the number of water filtration plants and the use of chlorine for water sterilization, alone or in conjunction with filtration, have produced a new and varied group of water analysts. Many small water purification plants are now creditably operated by men who have never had an opportunity to become "thoroughly grounded in the principles of chemistry and biology" or to acquaint themselves with the "leading literature upon the subject," but who have been taught by a representative of the State Board of Health or by some other competent person to make a few chemical and bacteriological determinations as outlined in Standard Methods of Water Analysis, the only text book that they possess. We should endeavor to educate such men whenever possible to a broader knowledge of analytical methods. In the meantime, however, the effluent of the water purification plant must be kept as pure as possible and the health of the people served must be protected. After all does not the ultimate value of water analysis rest upon the conservation of health, and is not the health of the community the final criterion by which the purity of a water supply is judged?

The Report of the Committee on Standard Methods published in 1904 has been evolved into the present Standard Methods for the Examination of Water and Sewage, with few changes in the chemical methods of analysis and many changes in the bacteriological methods during the intervening years. The present Standard Methods has become the standard text book, in many cases the only text book in the hands of men who are in charge of the operation of small water purification plants. Why then should it not be admitted that Standard Methods is a text book and that some attempt should be made to meet the demands that are made upon it?

It is the purpose of the writer to point out here the changes that he believes should be made in Standard Methods and to suggest new material that should be added in order to meet the present day demands of the water purification plant operator. The discussion of the various subjects will be made under the headings as they appear in the fourth edition of Standard Methods.

COLLECTION OF SAMPLES

Bottles

The formulae for cleaning solutions should be included.

Representative samples

Directions should be given for the collection of samples of water at the surface and below the surface of lakes and rivers. A cut should be inserted of some sampling device for holding the bottle when taking samples of water below the surface.

PHYSICAL EXAMINATION

Temperature

The words "if taken" should be omitted because temperature data are frequently valuable and the determination should be made.

A cut showing a thermophone should be inserted.

Turbidity

The turbidity determination is undoubtedly important but it appears to the author that undue space has been allotted to a description of the methods employed at the expense of brevity elsewhere in Standard Methods. The statement that the observation should be made "in the middle of the day, in the open air, but not in sunlight, and in a vessel so large that the sides do not shut out the light so as to influence the results" is delightfully entertaining but highly discouraging to most analysts. Would it not be much more scientific and satisfactory to every one concerned to accept the suggestion of the United States Bureau of Standards that it prepare a silica standard for distribution to water laboratories? The Bureau has recently shown that silica standards in use in various laboratories, all made according to the directions given in Standard Methods, vary greatly.

A cut showing a standard United States Geological Survey turbidity rod should be inserted.

A table should be added to show the quantities of the stock silica suspension to be used with distilled water in making up the silica standards.

A cut showing a candle turbidimeter should be inserted.

Color

A table should be added to show the amounts of stock color solution to be used in the preparation of the color standards.

The writer has found the Berkfeld Army filter number 3 very satisfactory for filtering turbid water previous to determining the true color.

A cut of some simple device for holding color tubes and having a movable lower mirror for reflecting the light through the tubes and upon a movable upper mirror would be a valuable addition.

A cut of the United States Geological Survey color tubes and discs should be inserted.

CHEMICAL EXAMINATION

A general statement should be given of the value of the various chemical determinations in the analysis of water from various sources. For example the author has found that the ammonia nitrogen, albuminoid nitrogen, nitrite, nitrate and residue on evaporation determinations have little value as routine tests in the control of a water purification plant. These determinations may be of value in arriving at a fair opinion of the quality of an unknown water.

The cut of the device for holding color tubes would also serve as a suggestion for a rack to hold the nitrogen standards if the device were made long enough.

RESIDUE ON EVAPORATION

Total residue

There is confusion caused here by the recommendation of either 103°C. or 180°C. as the temperature for heating the residue. One temperature only should be selected and made authorative so as to make all results comparable. The same criticism applies to the determination of suspended matter by the Gooch crucible method.

HARDNESS

The general definition of hardness should be rewritten with a view to clearness of expression. Some statement should be added of the reasons why a hard water is undesirable for steam boilers and for domestic use.

An effort should be made to discourage the use of the expressions "temporary hardness" and "permanent hardness" as they have outlived their usefulness. The author prefers a division of total hardness into carbonate hardness and non-carbonate hardness as these terms more nearly meet the actual conditions found in boiler water treatment and water softening problems.

Total hardness by soap method

If it is permissible to use either ethyl alcohol or methyl alcohol in making the standard soap solution then this statement should be added.

In the table showing the amounts of hardness equivalent to the various amounts of soap solution added there is an error which has survived all editions of Standard Methods. The hardness equivalent to 3.5 cc. of soap solution should be 39 instead of 38.

The author regrets that the volumetric methods for the determination of calcium and magnesium have been omitted in the later editions of Standard Methods as these methods are found useful in boiler water analysis.

Alkalinity

The statement in the First Edition of Standard Methods relative to the reasons for using phenolphthalein as an indicator in determining carbonate alkalinity is preferred to the condensed statement appearing in the Fourth Edition.

The colorimetric method of hydrogen ion determination should be described and the use of this method should be encouraged.

Mineral analysis

A statement might well be included to indicate a uniform method of reporting the results of mineral analysis as there is at present a great lack of uniformity in such reports. The author prefers the ionic form for such data. If the ions found to be present are to be combined in the form of definite chemical compounds, a definite order of combination should be indicated.

Dissolved oxygen

There should be a cut illustrating the device for use in collecting samples of water from a lake or river.

ANALYSIS OF SEWAGE

There should be a general heading "Analysis of Sewage" and a statement to indicate the determinations that are recommended in sewage analysis.

BACTERIOLOGICAL EXAMINATION

Sample bottles

The author has found metal capped glass stoppered bottles to be most satisfactory for use in collecting samples for bacteriological examinations.

Preparation of culture media

The phenolphthalein method of titration for adjusting the reaction of culture media should be omitted, substituting therefore the hydrogen ion concentration method with full description.

Collection of samples

There should be given specific directions for the collection of samples from different sources. Sterilization of taps by flaming previous to the collection of samples should be emphasized. A cut should be inserted showing some simple device for holding the bottle when taking samples below the surface of basins, lakes or rivers.

Interpretation of results

It is highly desirable that there be included a detailed statement on the interpretation of results, both chemical and bacteriological, even though the title has to be changed from Standard Methods for the Examination of Water and Sewage to Handbook for Water Analysts or some similar title. It appears entirely logical to include such material since Standard Methods has already been accepted as a text book.

There should also be included some statement relative to standards of quality. The United States Treasury Department Standard should be given, not because it is the universally accepted standard, but because of the fact that many water purification plants

are required to meet this standard, if the water they supply is to be certified by State Boards of Health for use by interstate carriers.

In the mind of the author there is only one standard for the bacterial content of a filtered water and that is sterile water—an ideal standard, to be sure, but one that is well worth seeking.

SANITARY SURVEY

A statement should be made of the value of a sanitary survey when determining the purity of a water supply. There are many cases where such a survey has been the deciding factor and has produced results entirely at variance with the analytical data.[3]

CONCLUSION

The writer is fully in accord with the recommendations of the Committee on Official Standards of Water Analysis of the American Water Works Association as published in the JOURNAL for September, 1921.

After such an official committee has been organized, with representatives from the various cooperating societies named, it should be its duty to revise the Standard Methods yearly and to have the same published in an annual edition, paper bound if necessary to reduce the cost.

New and frequently valuable methods of analysis, especially bacteriological, are appearing in various journals and are adopted by some laboratories whereas others continue to use the older methods. The result is a lack of uniform methods of analysis and of comparative data.

If we admit that standard methods of water analysis are essential for use in all laboratories, for the purpose of securing data that are comparable, then such methods should be as comprehensive as possible, should be stated in simple terms and in sufficient detail so that the need for reference to other text books is reduced to a minimum.

[3] JOURNAL, May, 1920, page 278.